Attorney Docket No. 588AW [2681.3184.001]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	**Brian W. Brandner et al**
Ser. No.	10/726,182
Filed:	December 2, 2003
For:	Fuel System Component and Method of Manufacture
Examiner:	Shawn M. Braden
Group Art Unit:	3727

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

Rule 131 Declaration of Brian W. Brandner

Brian W. Brandner, first being duly advised of the penalties for perjury, hereby deposes, declares and says:

1. I earned a Bachelor of Commerce Degree in 1981 from the University of Windsor, have 25 years of experience in design, development and manufacture of plastic components including 10 years of experience in the design and development of plastic fuel tanks including plastic multi-layer fuel tanks, plastic nipples for fuel tanks and in attaching plastic nipples to plastic fuel tanks, and I am a named inventor in six U.S. patents and pending applications as set forth in my attached resume.

2. I am one of the named joint inventors of the subject matter disclosed in United States Patent Application, Ser. No. 10/726,182, filed on December 2, 2003 and defined by the originally filed and present claims thereof and I have read and understand the disclosure and claims of this application. This application is assigned to my employer, TI Group Automotive Systems, L.L.C.

3. I have been advised that United States Patent Application Publication No. 2005/0211298 filed as a continuation of Application 10/356,380 filed on January 31, 2003 and United States Patent Application Publication No. 2003/0124281 filed on December 27, 2002 have been cited in the subject application as prima facie prior art under Sec. 102(e).

4. Prior to December 27, 2002, and in Canada of North America, the other joint inventors and I conceived the invention and subject matter of our United States Patent Application, Ser. No. 10/726,182 as evidenced by the attached **Exhibit 1** which was created and disclosed to others in confidence in Canada and in the United States of America prior to December 27, 2002.

5. Prior to December 27, 2002 and in the United States and utilizing the facilities of our assignee TI Group Automotive Systems, L.L.C., prototype tooling was obtained and utilized to produce prototype multi-layer plastic nipples for multi-layer fuel tanks and other multi-layer plastic parts and the invention and subject matter of our United States Patent Application, Ser. No. 10/726,182 was actually reduced to practice as evidenced and

shown in the photographs of the attached **Exhibit 2** of the prototype tooling and of the fuel tank nipples and other parts produced from a multi-layer plastic material, all of which occurred in the United States and all of which acts were performed, taken, recorded and disclosed in confidence to others prior to December 27, 2002.

6. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Sect. 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the subject application or any patent issued thereon.

7. Further I sayeth not.

Date:
August 6/07

Brian W. Brandner

Exhibit 1
of
Rule 131 Declaration of
Brian W. Brandner

THERMOFORMED FILL NIPPLE COMPONENT

Field of the Invention

This invention relates to thermoforming a fuel tank component (fill nipple) using multi layer sheet material or extruded parisin to provide a barrier to hydrocarbon emissions through this component.

Background of the Invention

HDPE 6-layer co-extruded blow molded fuel tanks are used for the fuel storage since the middle layer (EVOH) is a barrier for hydrocarbons. Wherever this layer is interrupted, like on the fuel tank openings and pinch-off areas for blow molding, there is a potential path for hydrocarbons to escape to the atmosphere through the HDPE material.

In the past, the components were made of monolayer HDPE and welded to the tank very well, and the only concern was if there was a good weld.

In order to meet the new emission standards (PZEV), unprotected surfaces that contact fuel or vapor, on the fuel tank have to be eliminated. So some of the components of the Fuel Storage and Delivery System (FSDS) have to be manufactured with a barrier material, for example, Roll-over Valve (ROV), connecting lines, and fill nipple. The component to be welded to the tank must have HDPE (blow mold grade) at the weld area.

One approach to solve this has been to make the components using a two shot or insert molded method (licensed by Norma Rasmussen). The main body of the component is nylon or acetyl or some other material that is a better barrier than HDPE. Then HDPE is added in the weld area of the component. The

problem is that these two materials have very dissimilar properties. Differential shrink rates produce stresses in the part. A chemical bond has not been achieved to date, adhesives have also not been successful and mechanical bonds alone will allow HC to migrate between the two materials. This condition is accentuated when the materials are exposed to fuel. The HDPE will swell significantly and the barrier material will swell slightly, creating a wider path for the HC or even separation of the materials and worst case a mechanical failure. Two shot is, to date, unreliable due to the above concerns.

Another method includes possibly 3 shot, where the barrier layer is encapsulated totally within HDPE, but this too leaves a natural path around the barrier layer.

The other approach is to use a seal and some sort of mechanical attachment to the tank. This is more expensive and presents more difficulties in manufacturing.

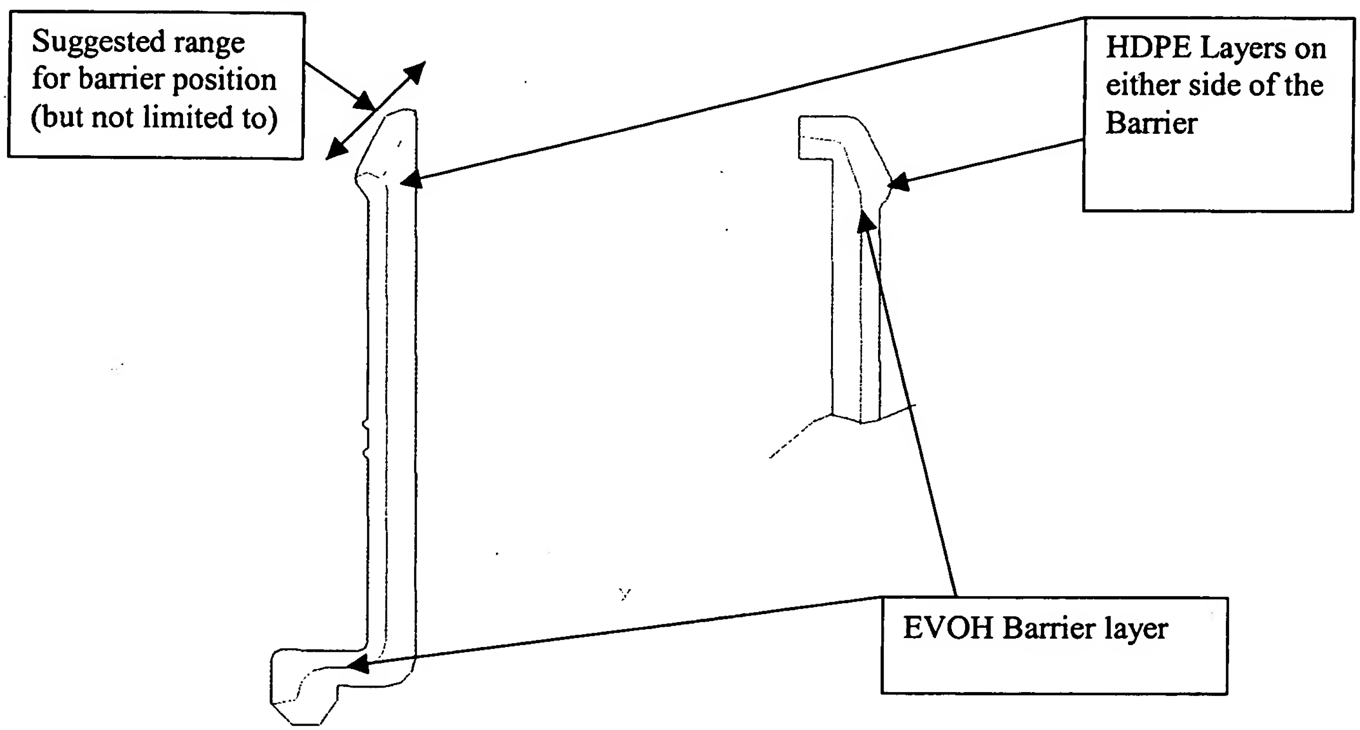
The method described below provides a compatible material component with good weld properties and that will reduce HC emissions due to barrier presence.

Summary of the Invention

We form the component using a thermoform method. This could be vacuum, blow or compression molded, using current multi-layer material configurations as used in the 6 layer Plastic Fuel Tanks. This structure allows the adhesion of the HDPE to the barrier (EVOH), and thus no path for HC. The

extruded multi-layer sheet (or parasin) is placed between the two mold halves. The molds come together in compression molding fashion, forming the parts. The parting lines are chosen carefully to have the barrier exposed for trimming at specified locations in the part. The part is formed and possibly trimmed in the mold. This could also accept an inserted piece to be encapsulated.

The other method to produce this on a rotary table-molding machine. Extrude a multi-layer parisin over a standing core, cut the parisin with laser to keep the end of the plastic open so no trimming is required. Then rotate to the next station where the cavity comes down to form the part. This would be a forming and shearing operation.



This illustration shows a standard fill nipple shape with the new multi-layer configuration. It also shows various locations for the barrier layer to be positioned depending on where we want it and how we mold it.

ADVANTAGES

- A multi-layer component with good weld properties
- No de-lamination due to swell or shrink differential
- Better performance than current multi shot, longevity, permeation and crash
- Reduces the expense of multi shot injection molds

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TI Automotive

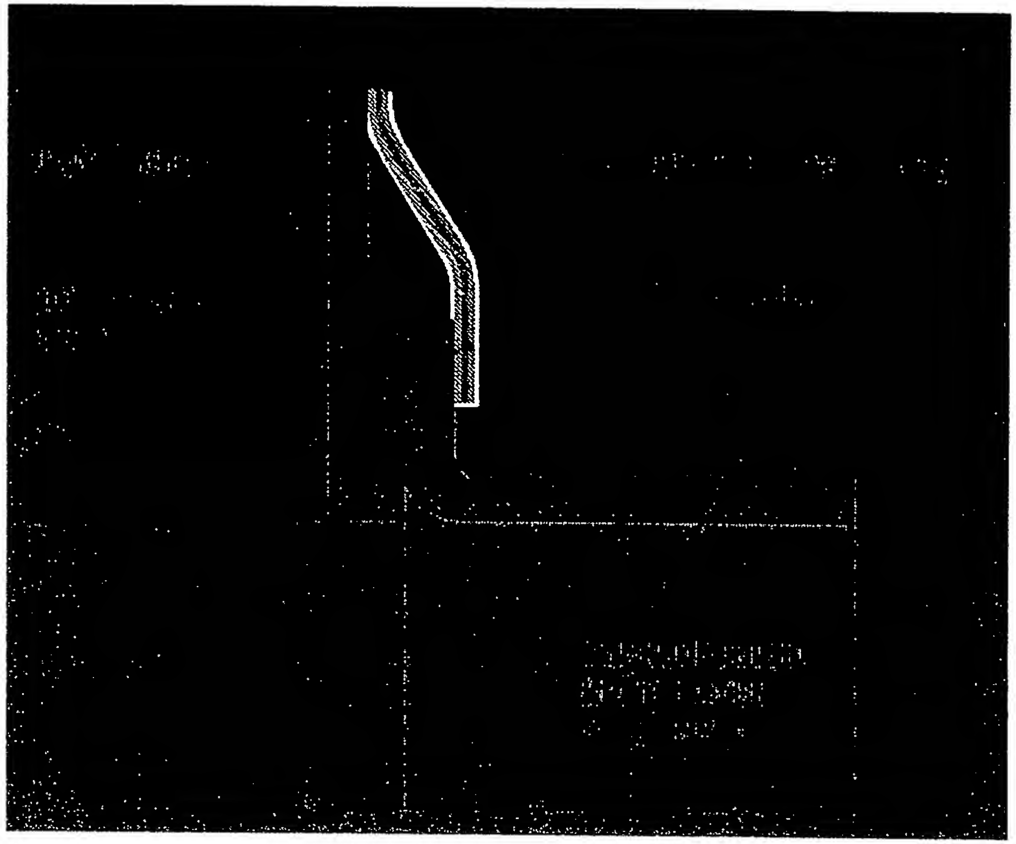
Thermoforming simulation software report

by Vladimir Franjo

FormSim software

- Software purchased from CNRC (same as BlowSim) primary for thermoforming of CVR covers
- Software can be used to simulate plastic heating and forming by pressure or vacuum
- It is possible to simulate local area wall thickness distribution in blow molding

TI Automotive *Multilayer Fill Spud thermoforming*



- Goal is to make the multilayer Fill spud that will be welded to the fuel tank in order to reduce permeation in this area

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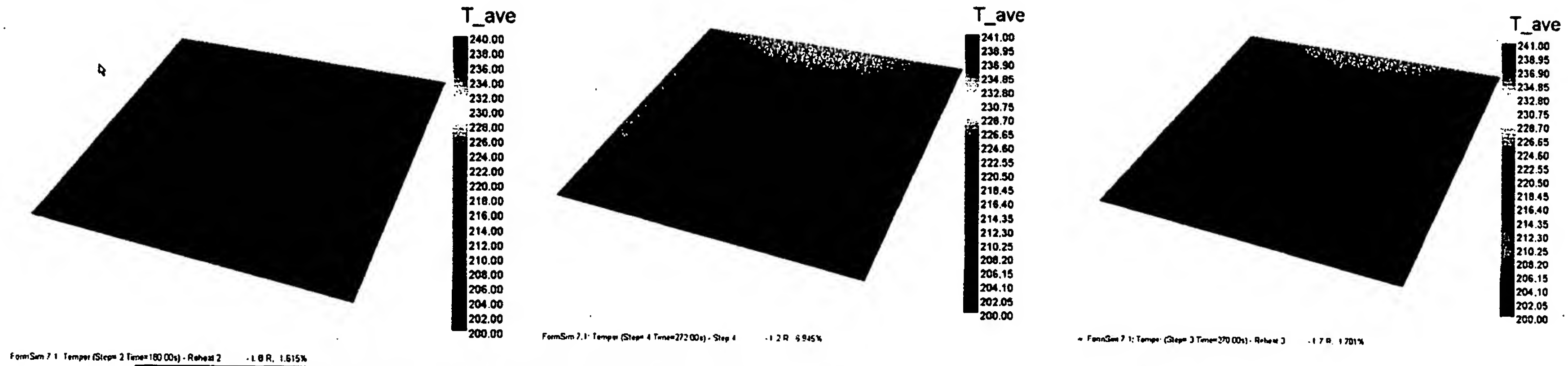
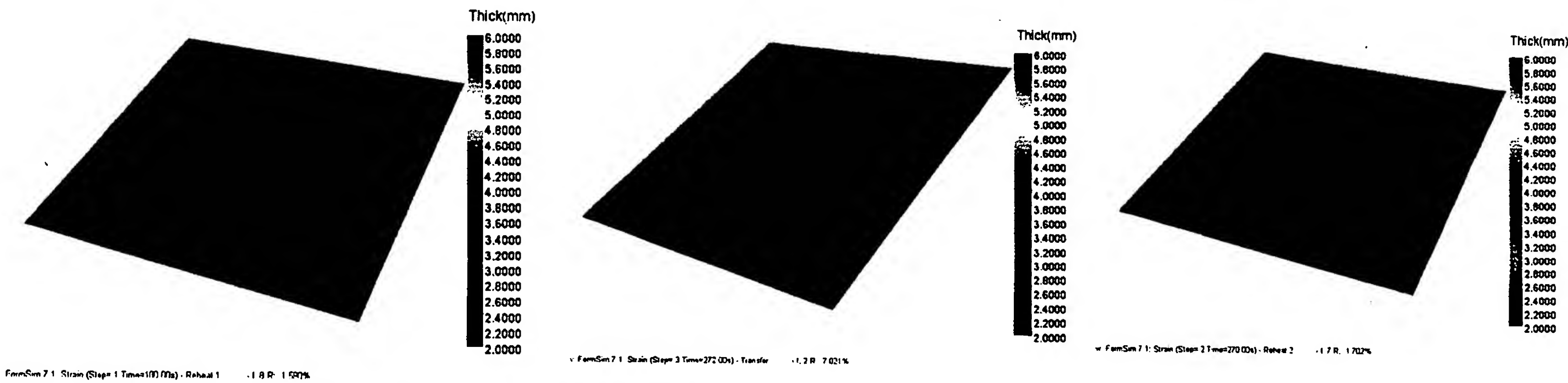
Wall thickness and temperature monitoring



Sheet pre-heating Temperature 200-240 degC



Sheet Wall Thickness and Sag while pre-heating

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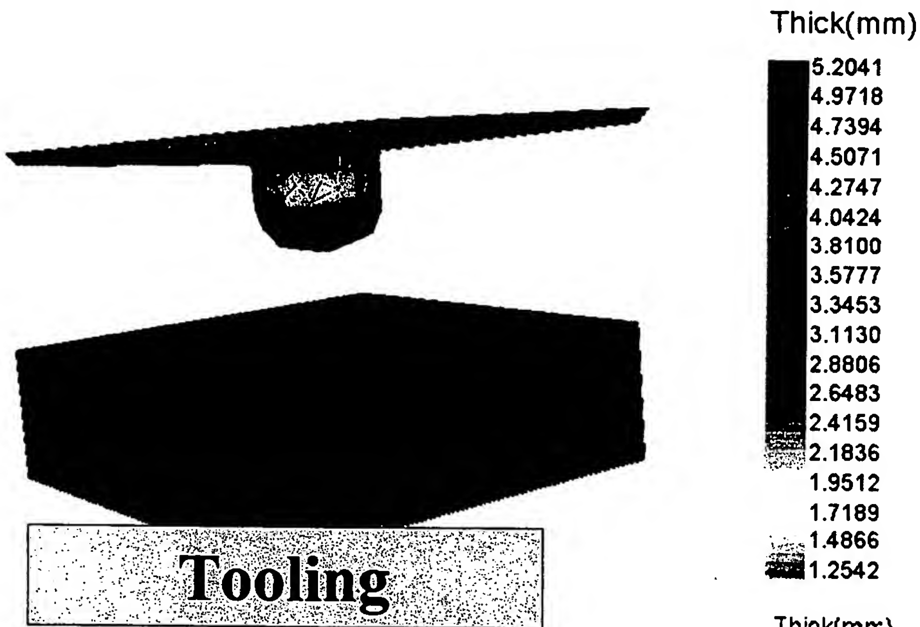
TI Automotive Multilayer Fill Spud thermoforming 1



- Vacuum forming into the female form resulted in very low wall thickness (0.5mm) at the end of the fill spud
- Sheet thickness 6mm

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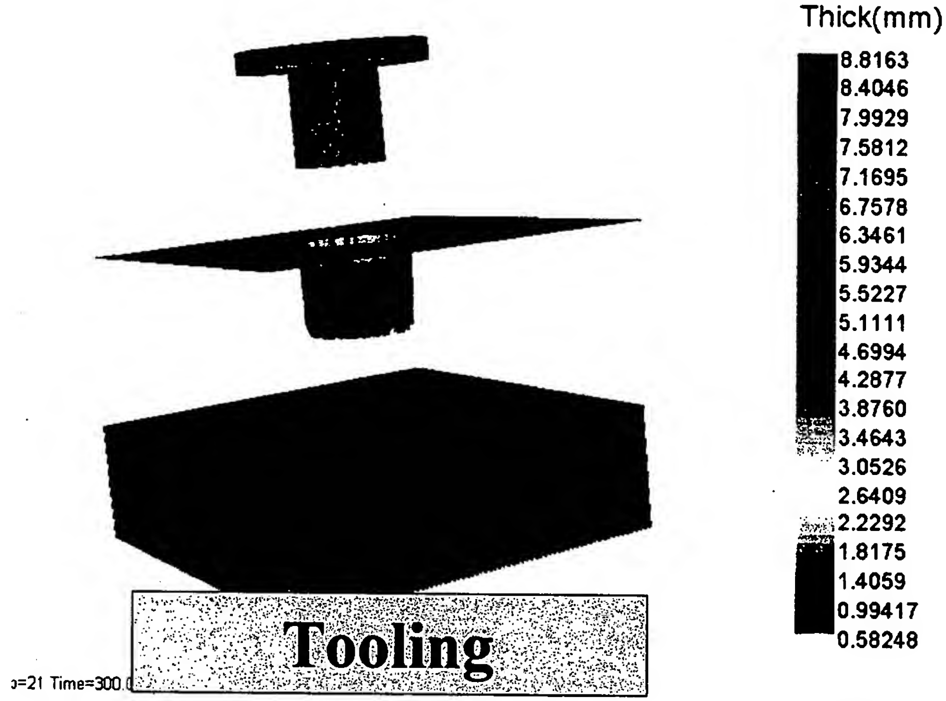
TI Automotive Multilayer Fill Spud thermoforming 2



- Plug-assisted vacuum-forming into the female form resulted in the low wall thickness (0.5mm)
- Plug moves down before the vacuum is turned on

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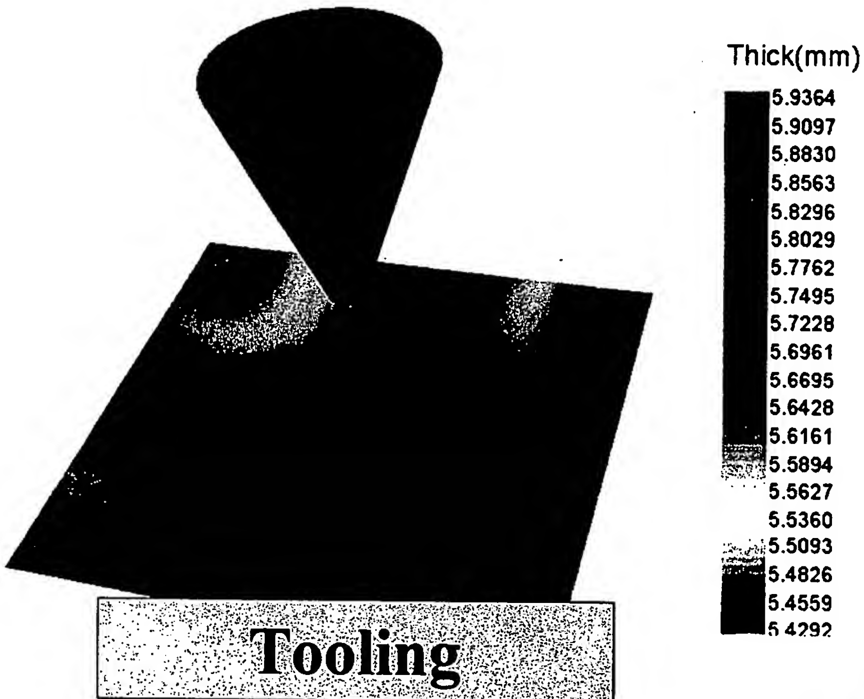
TI Automotive *Multilayer Fill Spud thermoforming 3*



- Modified Plug geometry still resulted in the low wall thickness (0.5mm)
- Plug moves down before the vacuum is turned on

ırmSim 7.1: Strain (Step=22 Time=300.00s) - Cool 1 - I: 2 R: 1.546%

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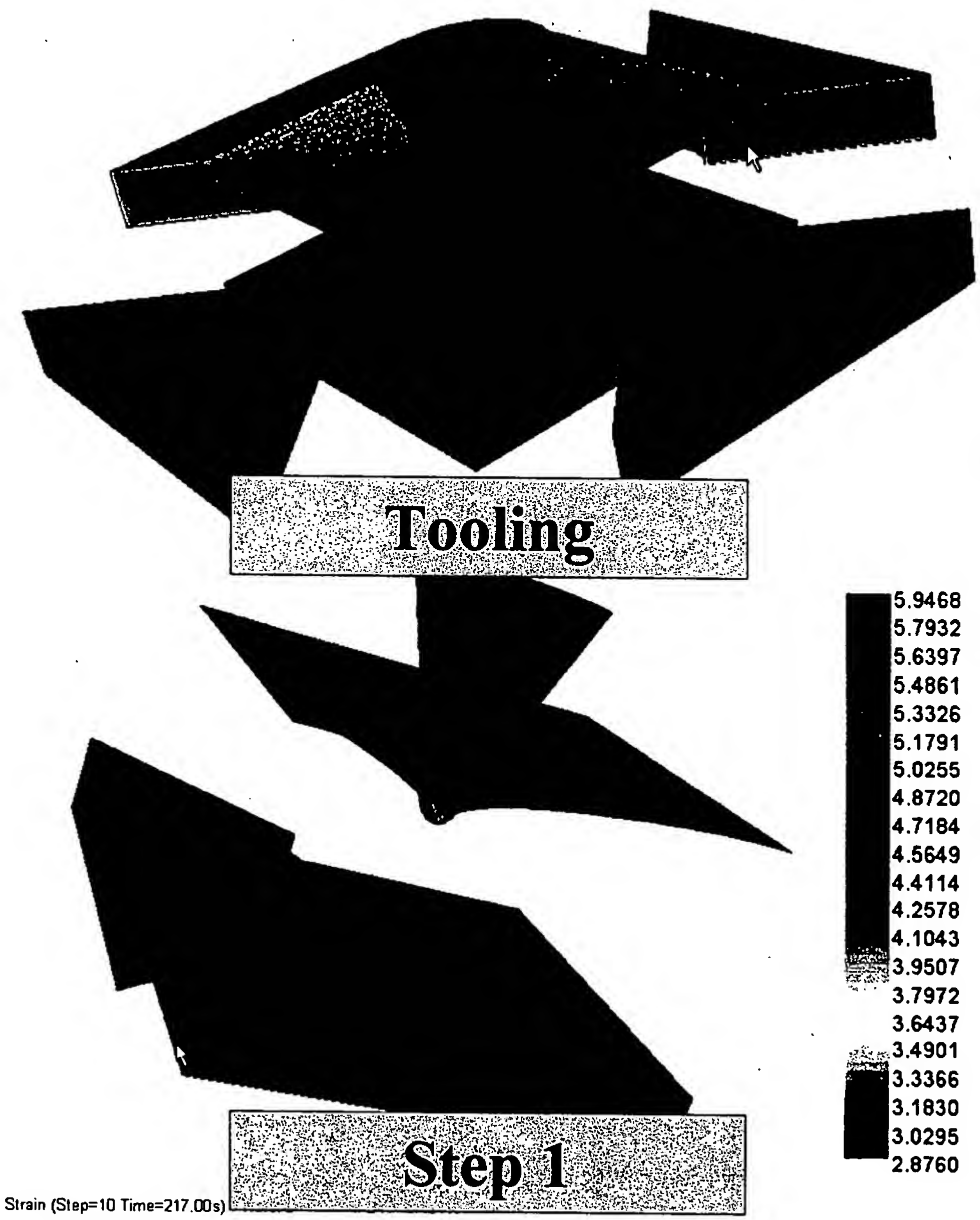
Multilayer Fill Spud thermoforming 4



- 4 slides added to the female form (needed for de-molding as well)
- Step 1: Plug moves down
- Step 2: 4 Slides move in
- Step 3: Vacuum on in the female form

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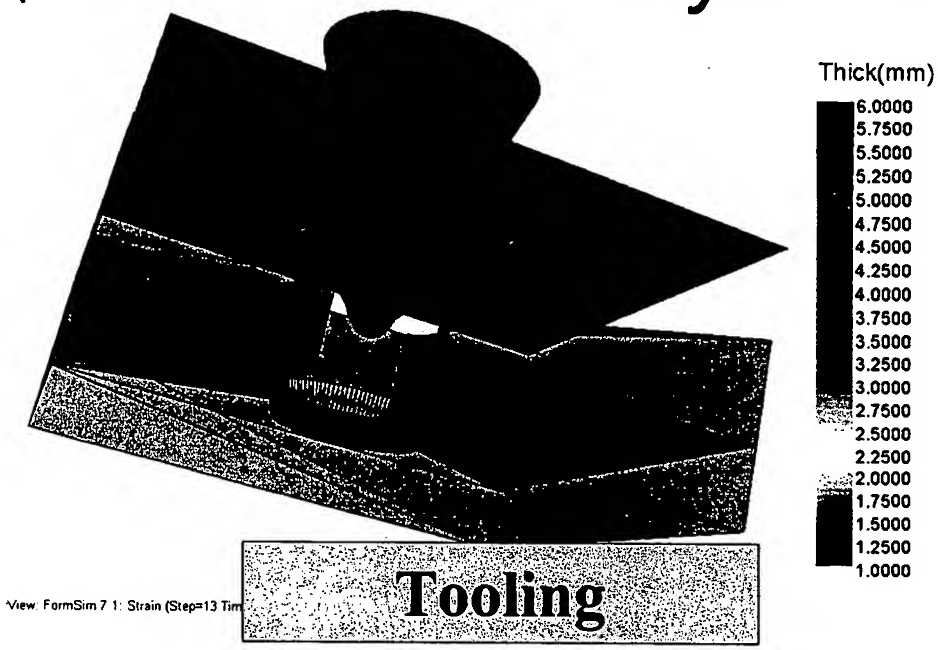
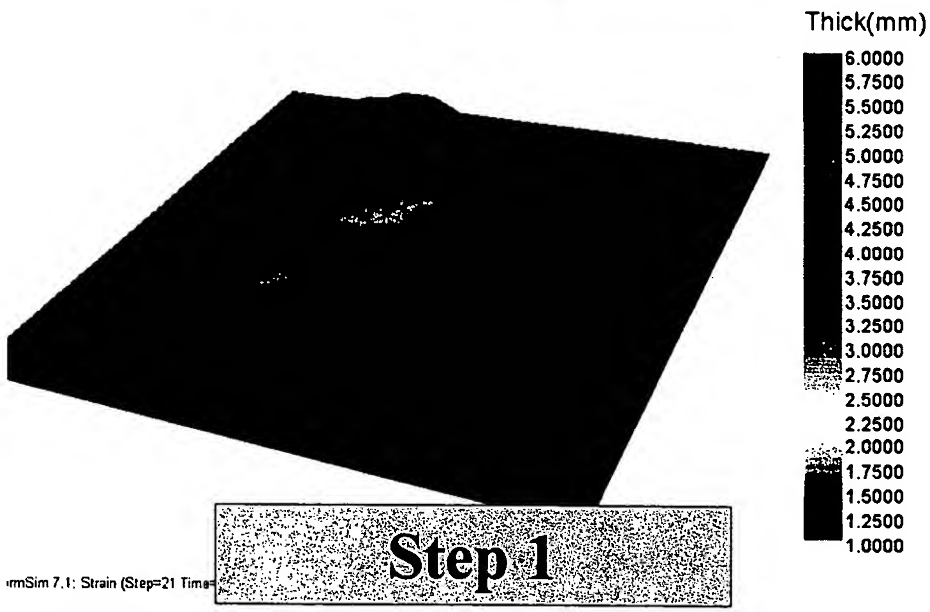
Multilayer Fill Spud thermoforming 4





- Slides created folds as they moved in
- End wall thickness improved but still thin (1mm)

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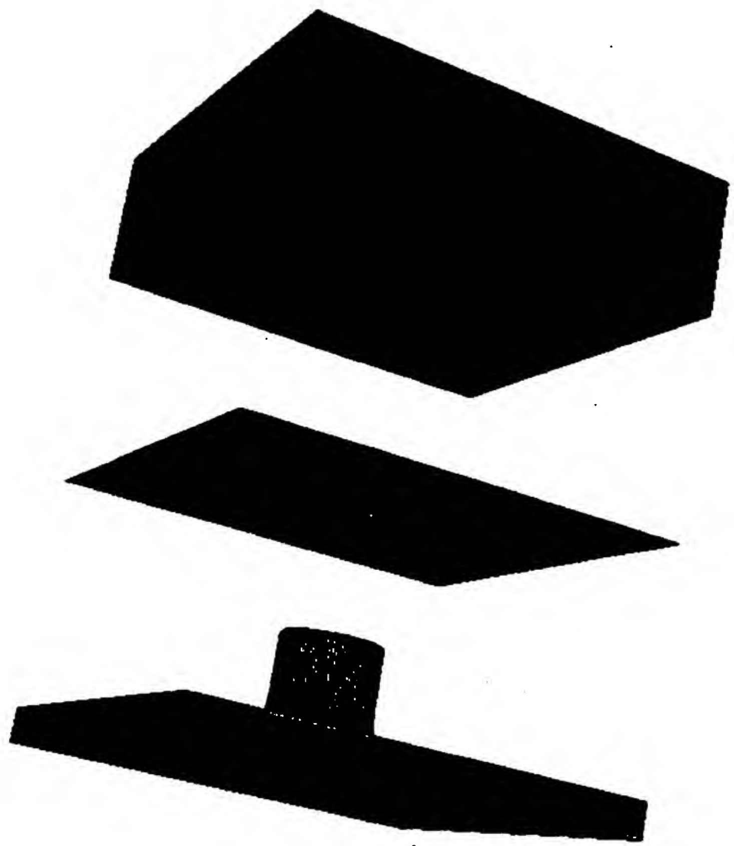
Multilayer Fill Spud thermoforming 5



Tooling

- Reversed approach to forming
- Sheet is first pre-formed by vacuum on the male form
- Female form then comes down and compresses critical areas (weld pad and top flange)
- Vacuum is turned off the male form and turned on the female form

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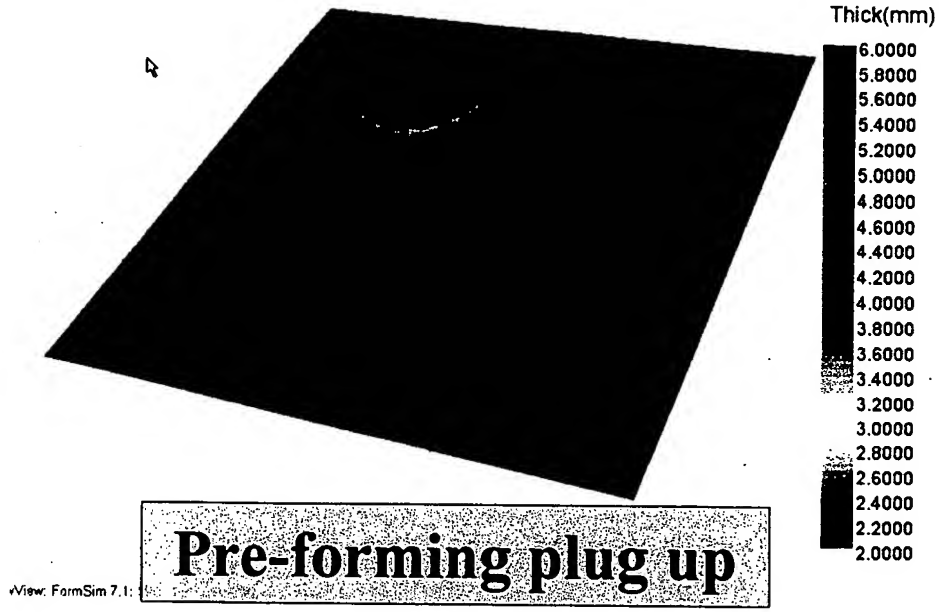
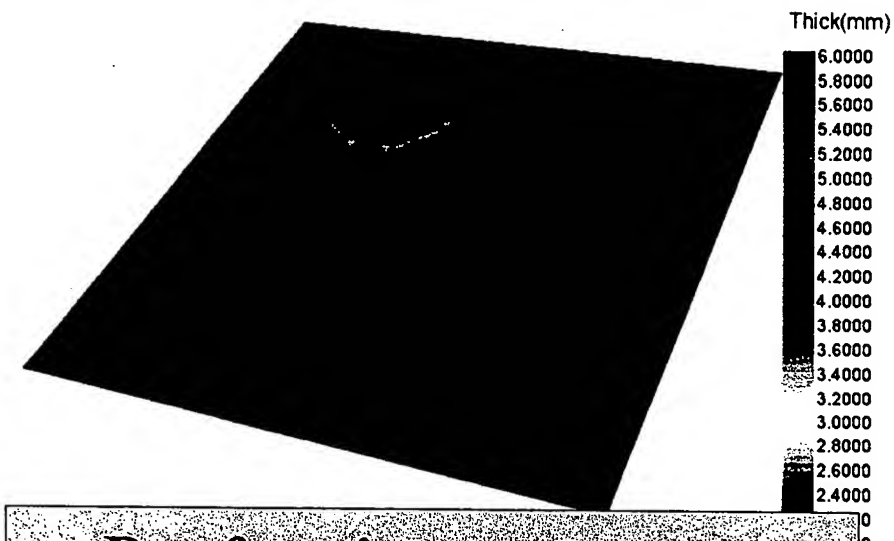
Multilayer Fill Spud thermoforming 5



Pre-forming plug up



Pre-forming vacuum on

- Folds created when pre-forming on the male form
- Excess material on the side of the fill spud

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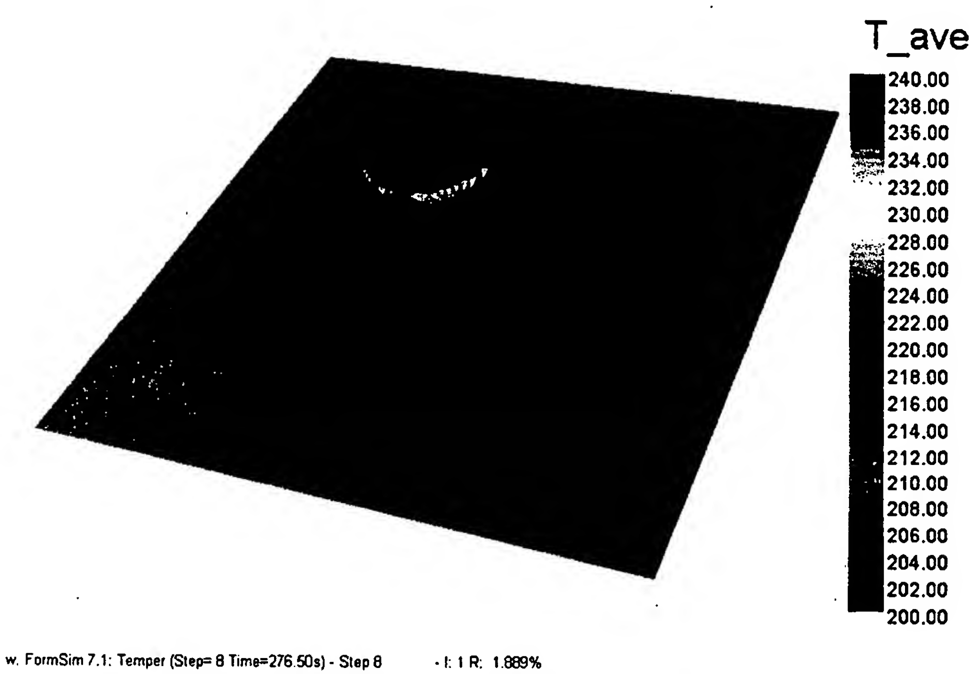
TI Automotive Multilayer Fill Spud thermoforming 5



Temperature profile after pre-forming

- Before the vacuum is switched to the female form it is critical that the temperature is high enough so the final forming can be done
- Temperature is around 220 degC
- Compression between the two forms can not be simulated

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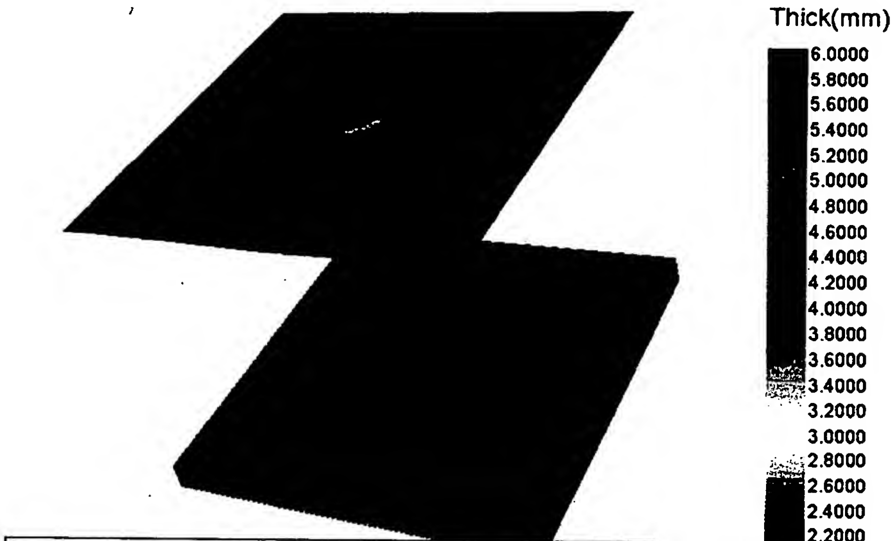
TI Automotive Multilayer Fill Spud thermoforming 6



Pre-forming plug shortened

Pre-forming vacuum on

- Shorter plug (male form) tried in order to eliminate folds
- Less material stretched up

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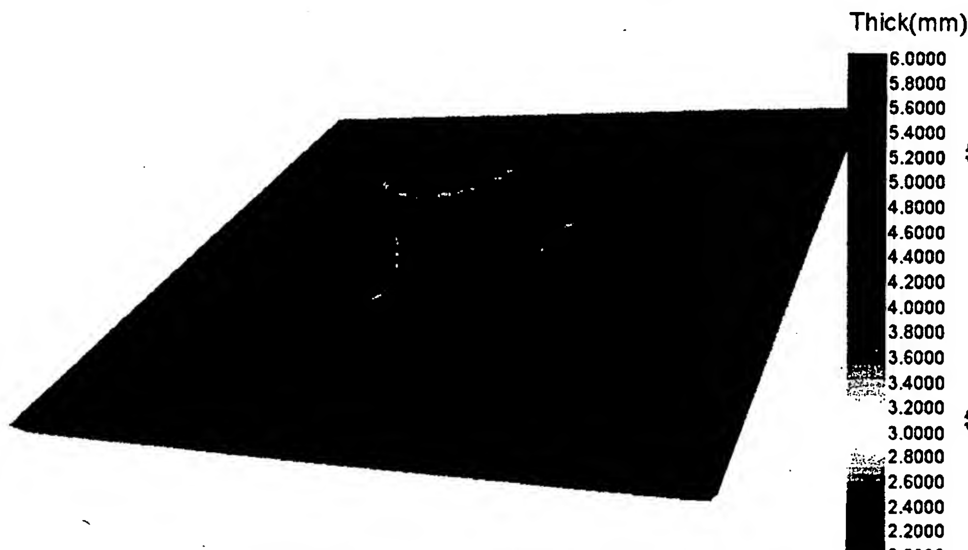
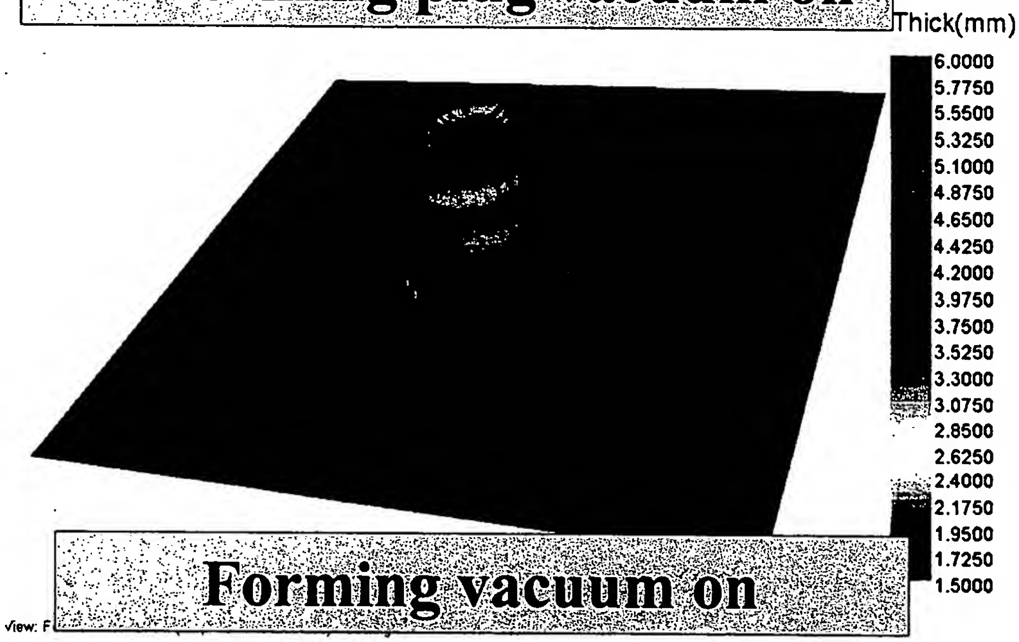
Multilayer Fill Spud thermoforming 6



Pre-forming plug vacuum on



Forming vacuum on

- Folding reduced, but it still exists
- Final results show satisfactory wall thickness distribution (overall between 2 and 4mm)

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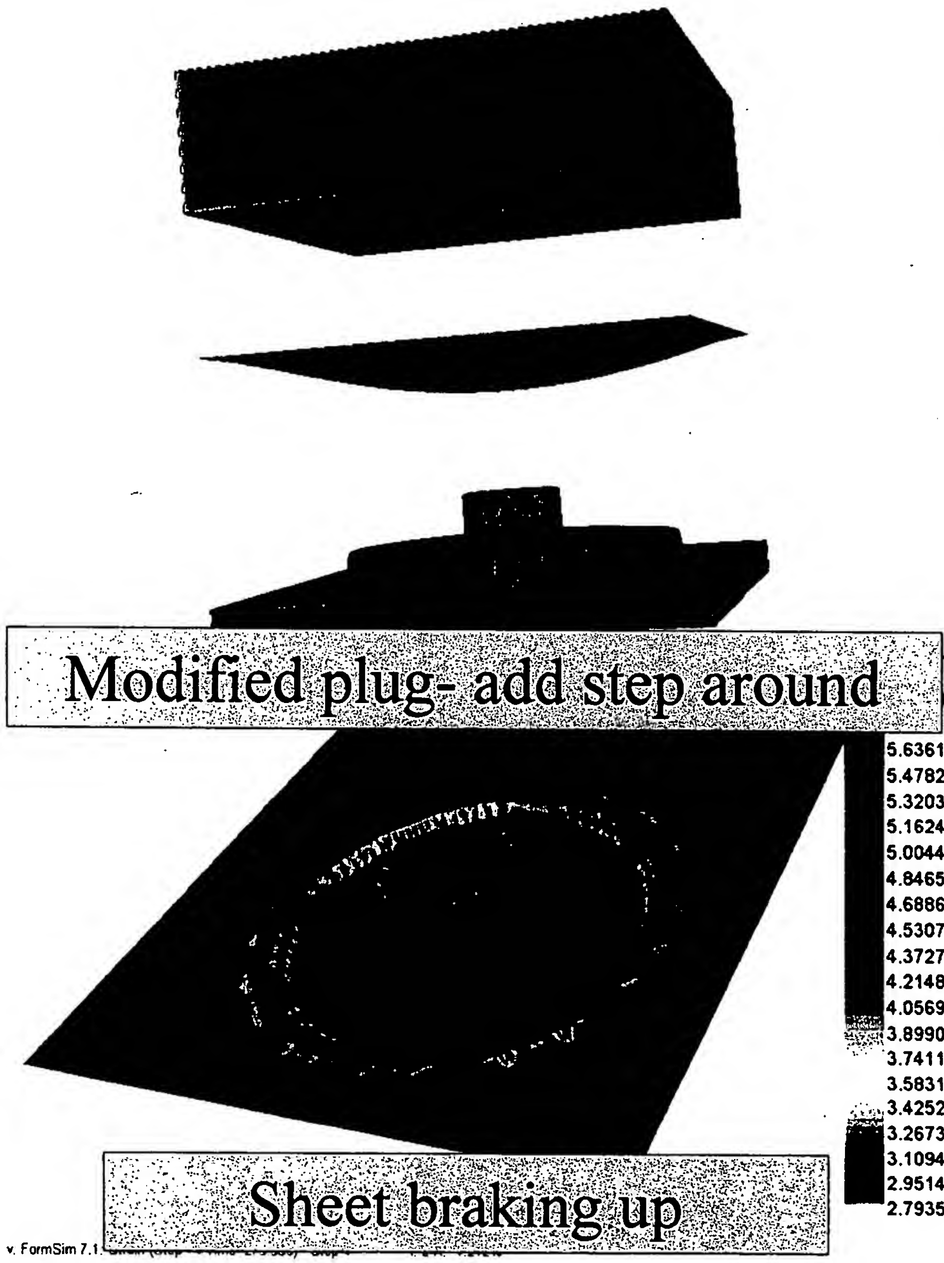
TI Automotive *Multilayer Fill Spud thermoforming 7*



- Modified plug (male form) in in order to try and remove folding
- Initial trial failed since the plug was too long and it was penetrating the sheet

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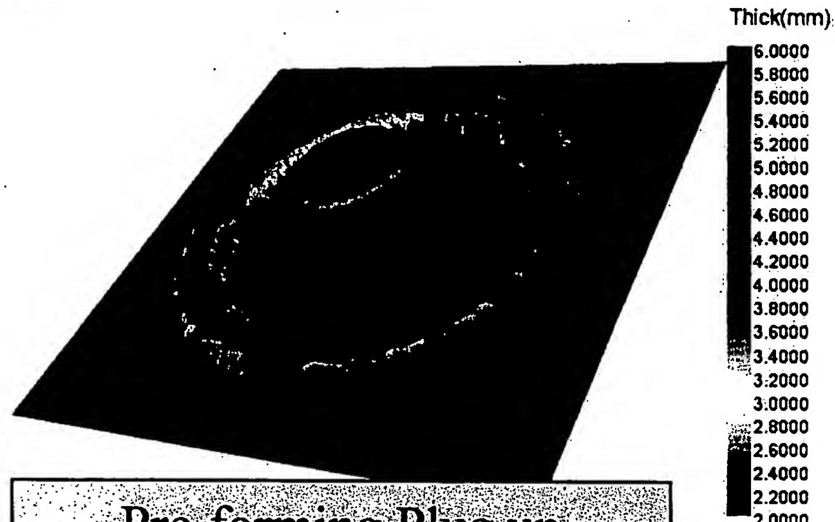
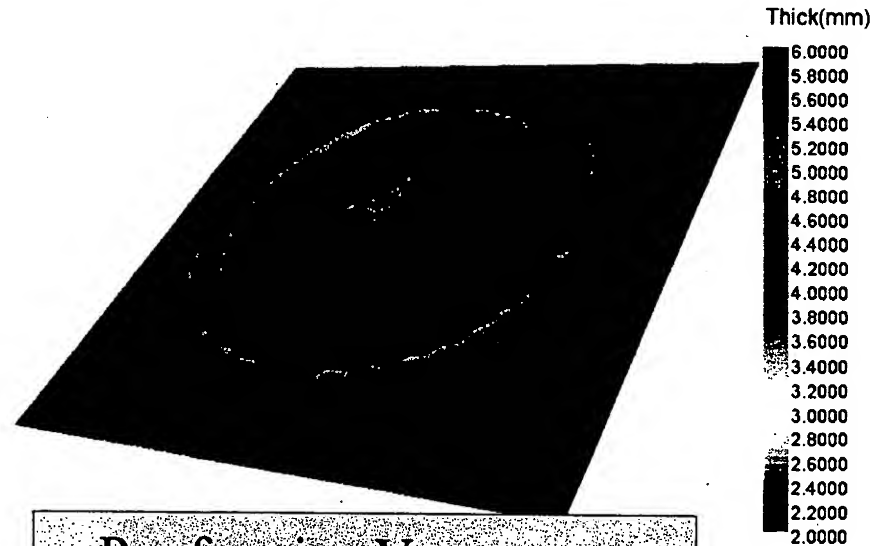
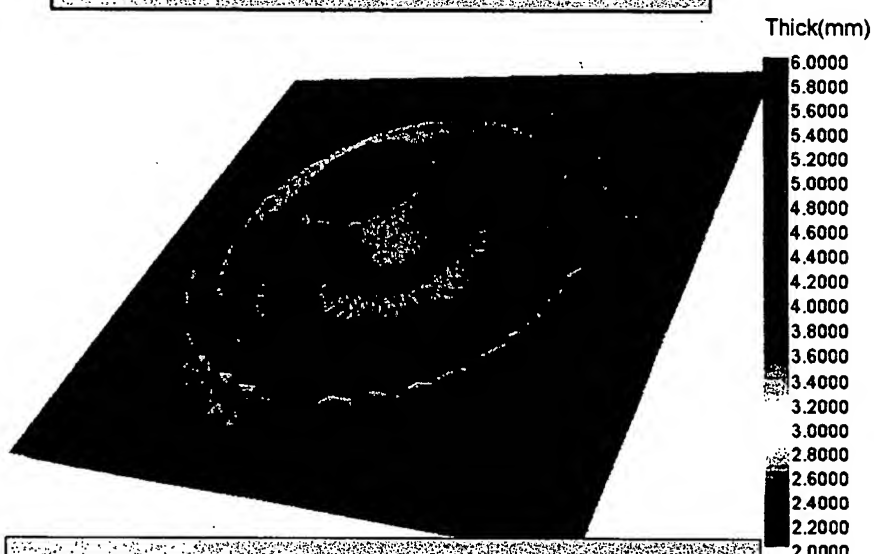
TI Automotive Multilayer Fill Spud thermoforming 8



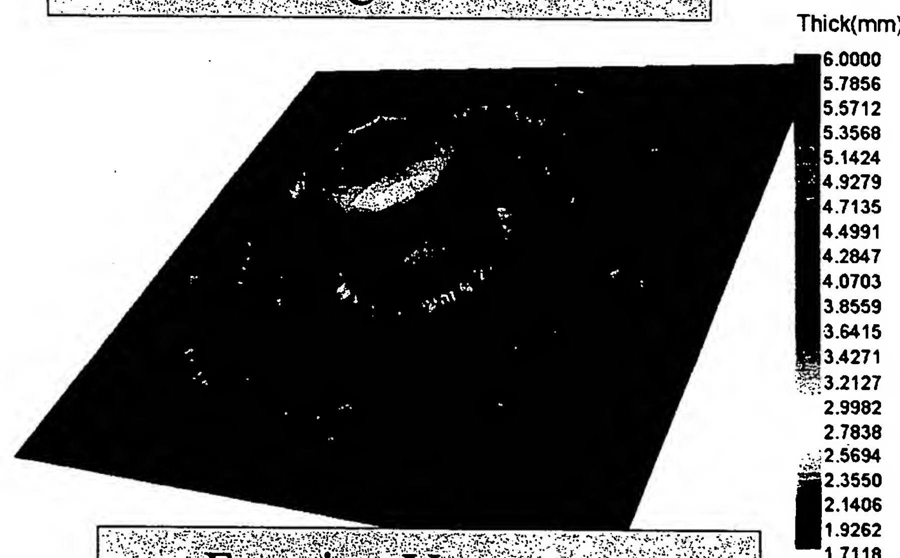
Pre-forming Plug up



Pre-forming Vacuum-on



Pre-forming Vacuum – No Folds



Forming Vacuum on

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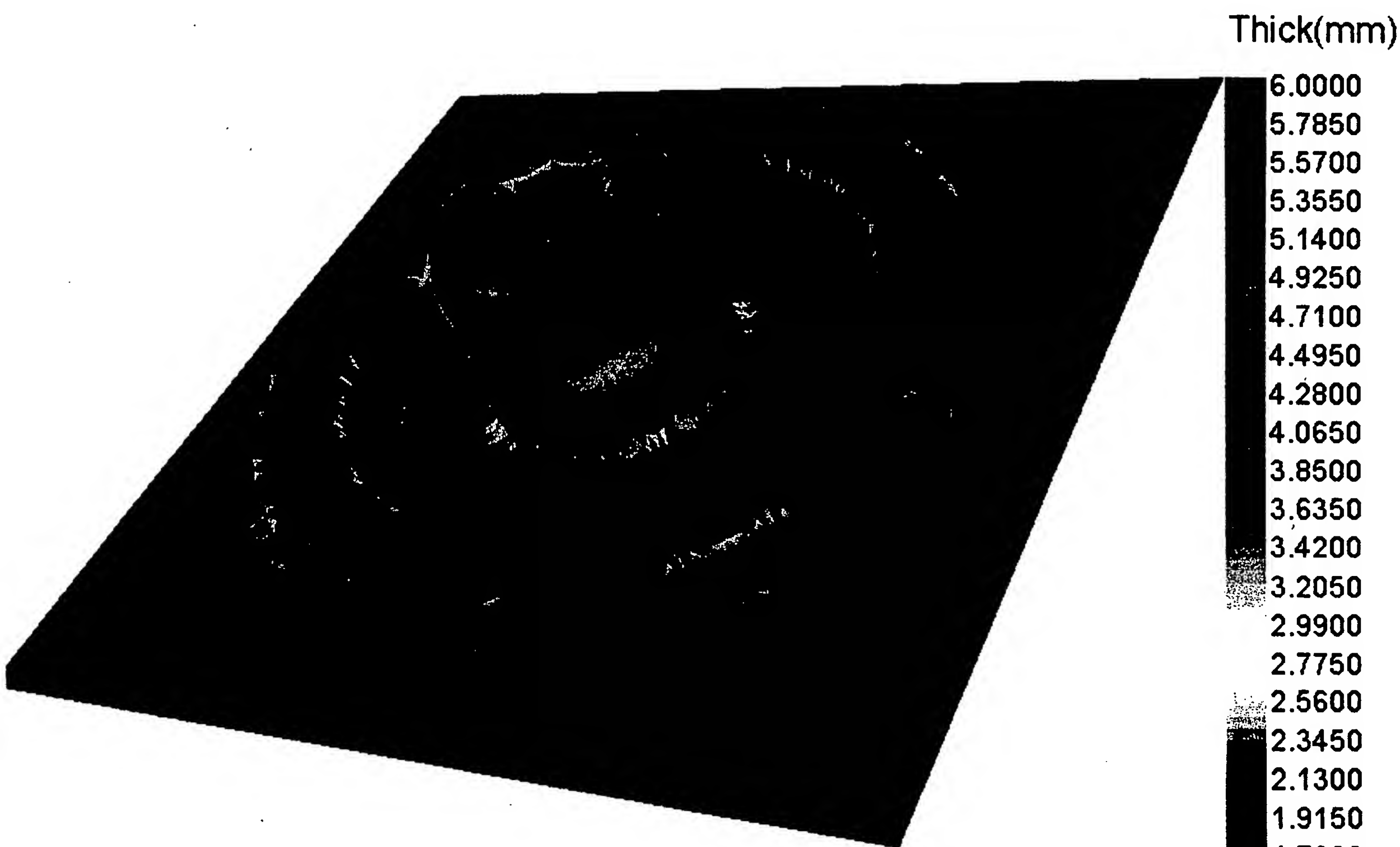
TI Automotive Multilayer Fill Spud thermoforming 8



Final Result

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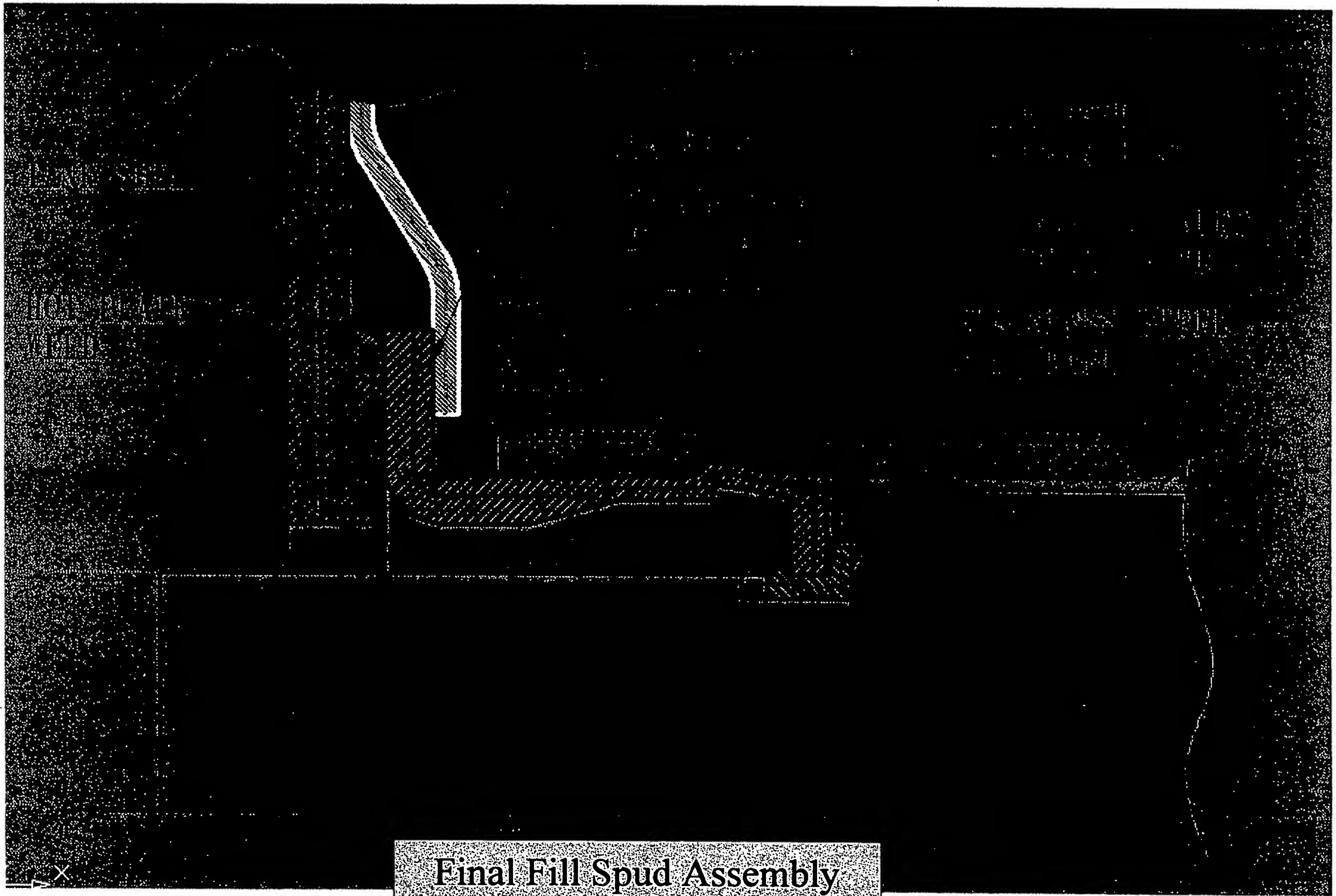
TI Automotive Multilayer Fill Spud Assembly



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Conclusions

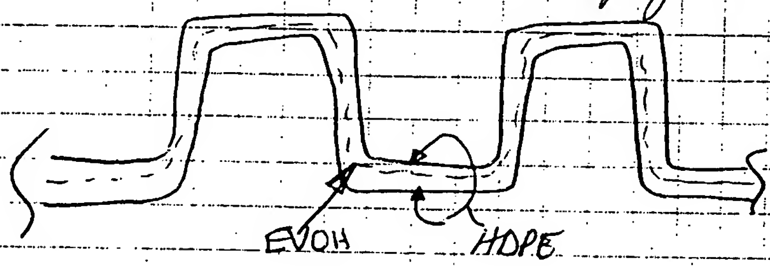
- Software can be used for simulating thermoformed components or local areas in blow molding
- Not successful with compression molding simulation
- Multilayer sheet thickness for CVR covers manufacturing can be estimated better, since it has to be ordered prior to the trial
- Very useful tool for determining the feasibility for thermoformed products
- One simulation took approx. 1 ½ hour (using an old PC)

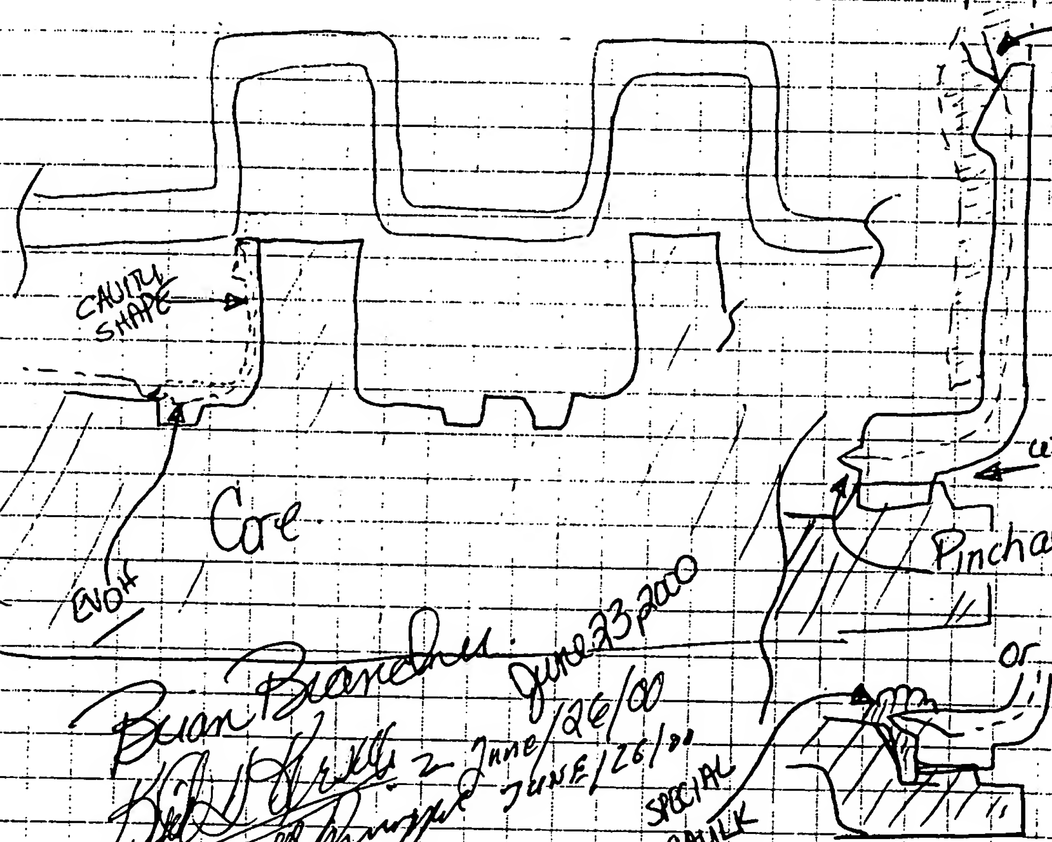
TITLE Multi-Layer (coex) Fill nipple Compression Molded.
CONTINUED

Project No.
Book No.

From Page No. 4 page 2 of 2.

(1) Produce the profile of multi-layer parison in a Blow Mold. This uses warm & malable material to be loaded into a compression style mold. (Placed on the core) (vacuum form?)
This can be molded singularly or with a number of cavities.
(2) Then the Cavity comes down shearing & pinching the material to form parts as sketched on page #4.





Brian Brandner June 23 2000
Keith Kersey June/26/00
Harold Knuppel JUNE/26/00

To Page No.

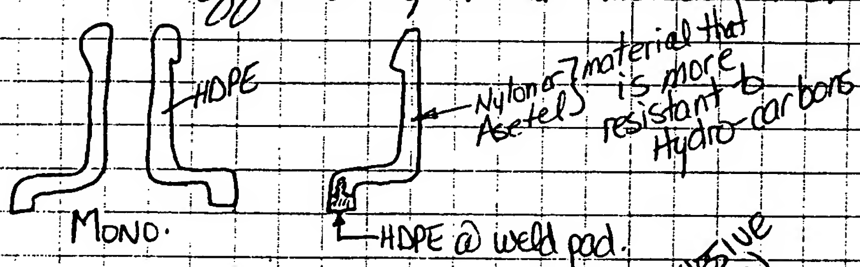
Witnessed & Understood by me,	Date	Invented by Brian Brandner, Keith Kersey, Harold Knuppel	Date
Robert Walty		Recorded by Brian Brandner	

Project No.______

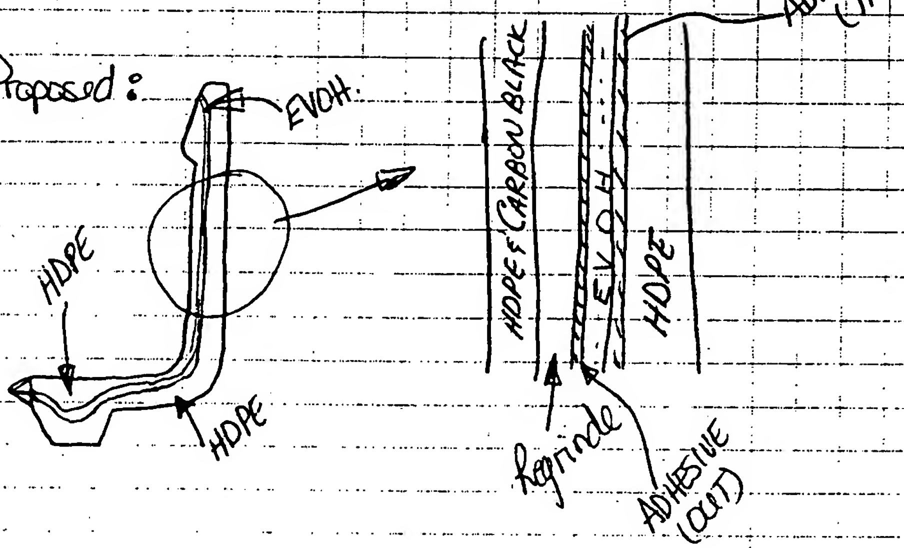
Book No.______ TITLE *MULTI-LAYER (CO-EX) fill nipple-Compression molded.*

From Page No.__ PROPOSED: Produce a coex fill nipple, not multi shot injection

Current: Mono layer fill nipples (spuds) 2K component as offered by Norma Rasmussen license.



Proposed:



Advantages: 6 layer component, weldable or encapsulatable to the Plastic, fuel tank: Better performance for resistance to hydrocarbon permeation.
- Good longevity
- Better impact resistance
- eliminates expense of multi shot tooling
- controle of wall thickness tolerances are low.
- do not need to encapsulate dissimilar materials as Norma Rassmussen uses.

To Page No. 5

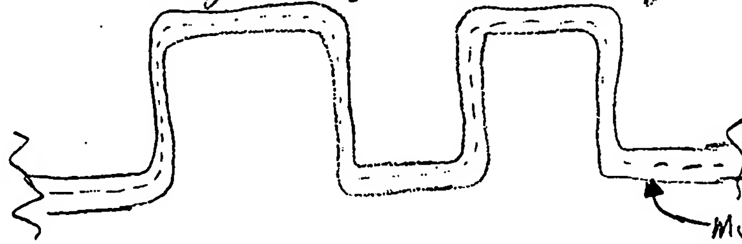
Witnessed & Understood by me,	Date	Invented by	Date
R L Walter		Recorded by	

Title Blow

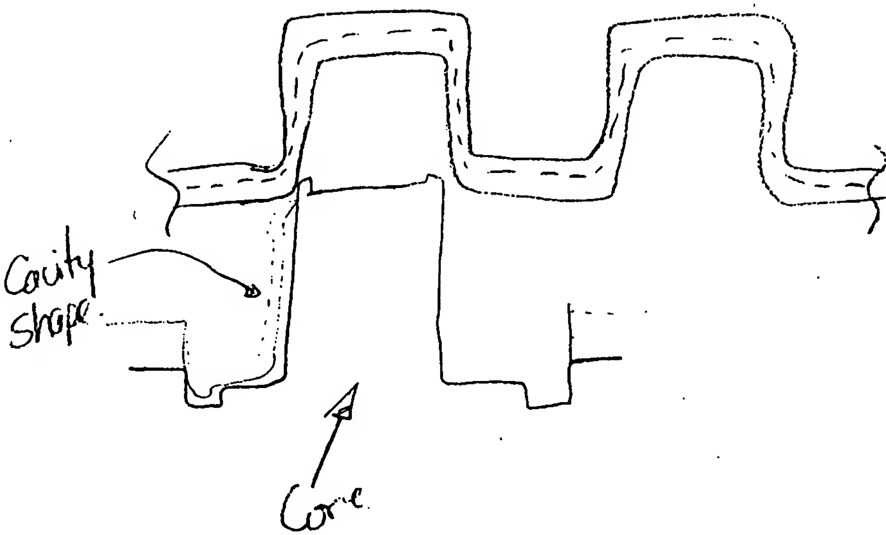
① Multi Layer fill nipple - compression molded, vac

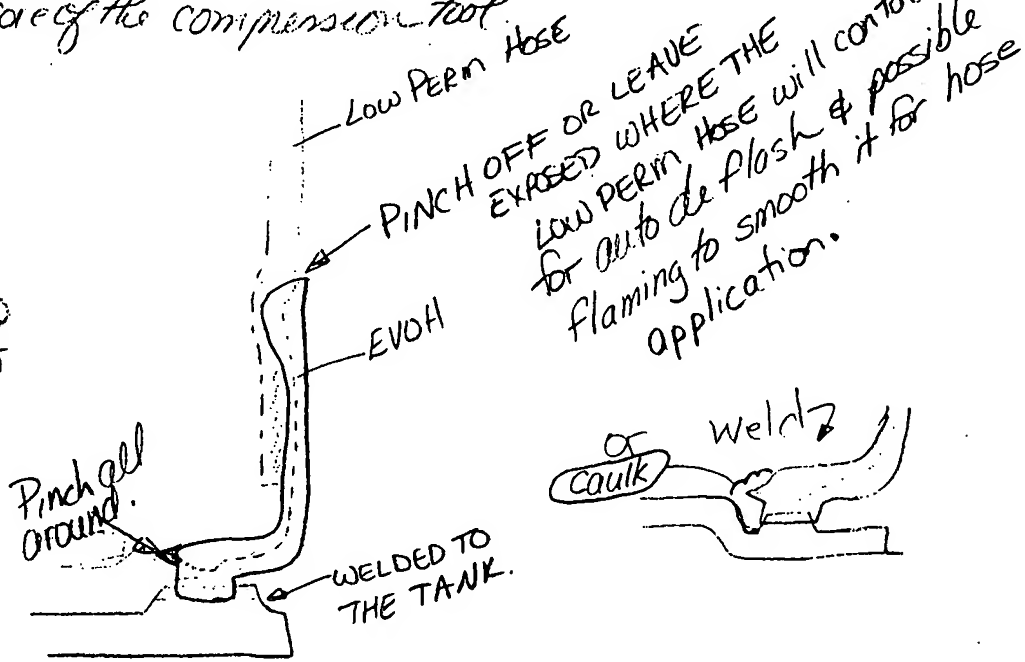
PROPOSED

produce profile of multi-layer parison in Blow Mold, long series of parts.



Remove from the blowmold & place on the core of the compression tool





Bring the 2piece Cavity down in compression mold fashion & shear the parts @ opening.

This can be welded or encapsulated into the blowmolded tank.

Advantages - multi layer component weldable to the tank without Norma Rasmussen licensing
- better performance than acetal, longevity & permeation
- eliminates the expense of multi shot & cam control, wall thickness better.

Exhibit 2
of
Rule 131 Declaration of
Brian W. Brandner